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# CHANGES IN THE PROPERTIES OF THE POTTING MEDIUM AND YIELD OF VEGETABLE COWPEA AS INFLUENCED BY COIRPITH AND METHODS OF FERTILIZER APPLICATION

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## ABSTRACT

Pot experiment was carried out during 1995-96 with vegetable cowpea (CO-2) to study the effect of potting mixtures (100% soil, 100% coirpith, 75% coirpith + 25% soil, 50% coirpith + 50% soil and 25% coirpith + 75% soil) and methods of fertilizer application (full dose of N and P as basal and 50% of N and P through fertigation + spraying) on physico chemical properties of the potting medium, yield and uptake of nutrients by vegetable cowpea. Incorporation of coirpith in the potting medium improved the physico-chemical properties of the potting medium. The number of root nodules in 100% and 75% coirpith medium were approximately 20 times than that of medium containing 100% soil. An yield increase of 83% and 50% were recorded in the treatments of soil + coirpith 25:75 and 50:50 respectively over 100% soil medium. the yield increase due to the fertigation + spraying method was 8.12% as compared to basal application alone. Fertigation + spraying method also improved the crude protein content of the pods.

KEY WORDS : Potting medium, coirpith, fertilizer application, physico-chemical properties, cowpea

Container grown plants require a growing medium with good physical and chemical environment for their growth. An efficient medium must be sufficiently firm and dense to hold the plants, sufficiently retentive of moisture and porous. Soilless cultivation offers many benefits that may help eliminate soil originated problems (aeration, sodicity etc.,) for crop growth. In the process of pot mixture preparation, materials such as peat, saw dust, tree bark and rice husk could be used (Verdonck, 1991). Coirpith is a non-disposable waste product of coir industry. Its use as a soil conditioner in tropical farming is well established and work on coirpith utilisation as potting medium is an established fact (Saravanan and Nambisan, 1995).

The soilless culture has low nutrient retention capacity due to heavy leaching by frequent irrigation which warrents standardization of fertilizer application methods so as to maintain continuous supply of nutrients in a favourable physical and chemical environment throughout the crop growth.

## METERIALS AND METHODS

Bulk soil (*Udic Haplustalf*) from Agricultural college and Research Institute, Coimbatore and coirpith from Vedapatti, Coimbatore district were collected and used as potmix component. The processed soil and coirpith were mixed as per the details of the treatment and filled at the rate of ten kg per pot. The experiment was conducted in factorial completely randomised design replicated six times (three replications for sampling at vegetative stage and three replications for harvest). The treatmental combination includes two methods of fertilizer application on five different ratios of potting mixtures.

### Treatments

### Methods of fertilizer application

| | |
|---|---|
| $M_1$ | N and P @ 25:50 kg $ha^{-1}$ as single dose at sowing. |
| $M_2$ | N and P @ 25:50 kg $ha^{-1}$ of which 50% of N and P was applied as basal and the remaining 50% of N and P was applied through fertigation at weekly intervals and two rounds of 3% DAP foliar spray at flowering and pod filling stage. |

**Potting media**

$T_1$ - soil + coirpith - 100:0 v/v

$T_2$ - soil + coirpith - 0:100 v/v

$T_3$ - soil + coirpith - 25:75 v/v

$T_4$ - soil + coirpith - 50:50 v/v

$T_5$ - soil + coirpith - 75:25 v/v

Cowpea seeds were sown at the rate of 2 seeds per pot. Routine culturai practices were adopted and yield of green pods were recorded. Potting mixtures were prepared as per the treatment and initial composite samples were collected from each mixture before the commencement of the experiment and were analysed (Table 1) for physical and chemical properties. Potting mixture samples were collected at flowering and at harvest stage and analysed for their physico-chemical properties. Plant samples were analysed for uptake computations employing normal methods.

## RESULTS AND DISCUSSION

### Pysical properties

Incorporation of coirpith in the potting medium (Table 2) significantly reduced the bulk density from 1.31 g $ml^{-1}$ (100% soil) to 0.589 g $ml^{-1}$ (75% coirpith + 25% soil) which might be due to increase in pore space. Similarly particle density was also reduced form 2.17 g $ml^{-1}$ to 1.30 g $ml^{-1}$ for the same sets of potting mixtures. Incorporation of coirpith in the potting medium improved the pore space and maximum water holding capacity which might be due to the high pore space and water holding capacity of raw coirpith (Saravanan and Nambisan, 1995). The pore space was slightly decreased from flowering to harvest stage which might be due to compaction of the potting medium. The maximum water holding capacity was increased from flowering to harvest stage due to decomposition of coirpith, compaction and reduction in non capillary pores. Methods of fertilizer application had no significant effect on physical properties of the potting medium.

### Chemical properties

The pH of the potting medium was significantly reduced by the addition of coirpith (Table 3) due to acidic nature of coirpith (Ganapathi, 1991) while the EC was increased due to high salt concentration of raw coirpith. Fertigation method increased the EC of irrigation water resulted by dissolved fertilizers (Papadopoulos, 1987). Eventhough the coirpith containing medium had higher salt concentration (0.754 $dSm^{-1}$ - 75% coirpith) than 100% soil medium (0.251 $dSm^{-1}$), the high yield was obtained from coirpith containing medium (75% coirpith) indicate that the exisisting level of EC was not harmful to cowpea growth.

Addition of coirpith improved the total N content of the potting medium as was reported by many workers. The rapid turnover of total N at post harvest stage with coirpith containing media could

**Table 1. Physico-chemical properties of the initial potting mixtures**

| Properties | Unit | $T_1$ | T2 | $T_3$ | $T_4$ | $T_5$ |
|---|---|---|---|---|---|---|
| Bulk density | g $ml^{-1}$ | 1.21 | 0.08 | 0.54 | 0.66 | 1.05 |
| Particle density | g $ml^{-1}$ | 2.12 | 0.38 | 1.11 | 1.33 | 1.81 |
| Pore space | per cent | 44.0 | 80.0 | 51.0 | 50.0 | 42.0 |
| Maximum water holding capacity | per cent | 45.0 | 863 | 106 | 74 | 52 |
| pH | | 8.5 | 6.7 | 7.5 | 8.0 | 8.2 |
| EC | $dSm^{-1}$ | 0.550 | 0.458 | 0.926 | 0.586 | 0.556 |
| CEC | (mol($p^+$)kg | 18 | 59 | 29 | 28 | 26 |
| Total N | Per cent | 0.035 | 0.450 | 0.280 | 0.150 | 0.073 |
| Organic carbon | Per cent | 0.49 | 27.41 | 11.31 | 2.70 | 1.14 |
| Available N | ppm | 65.8 | 102.0 | 99.0 | 85.3 | 78.3 |
| Available P | ppm | 7.1 | 7.9 | 10.2 | 9.5 | 8.9 |
| Available K | ppm | 245 | 800 | 575 | 450 | 375 |

$T_1$ : Soil + coirpith - 100:0 v/v ; $T_2$ : Soil + coirpith - 0:100 v/v $T_3$ : Soil + coirpith - 25:75 v/v ; $T_4$ : Soil + coirpith - 50:50 v/v $T_5$ : Soil + coirpith - 75:25 v/v

Table 2. Effect of treatments on physical properties of the potting medium

| Treatments | | Flowering stage | | | | Harvest stage | | | | Mean (stages) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bulk density ($g\ ml^{-1}$) | Particle density ($g\ ml^{-1}$) | Pore space (%) | Maximum water holding capacity (%) | Bulk density ($g\ ml^{-1}$) | Particle density ($g\ ml^{-1}$) | Pore space (%) | Maximum water holding capacity (%) | Bulk density ($g\ ml^{-1}$) | Particle density ($g\ ml^{-1}$) | Pore space (%) | Maximum water holding capacity (%) |
| $M_1$ | $T_1$ | 1.31 | 2.19 | 44.4 | 48 | 2.13 | 1.31 | 44.2 | 49 | 1.31 | 2.16 | 44.3 | 49 |
| | $T_2$ | 0.10 | 0.37 | 76.3 | 640 | 0.11 | 0.43 | 71.1 | 722 | 0.11 | 0.40 | 73.7 | 681 |
| | $T_3$ | 0.59 | 1.29 | 55.1 | 101 | 0.60 | 1.38 | 57.4 | 110 | 0.59 | 1.32 | 53.7 | 106 |
| | $T_4$ | 0.77 | 1.52 | 52.7 | 77 | 0.80 | 1.52 | 50.2 | 75 | 0.78 | 1.52 | 51.5 | 76 |
| | $T_5$ | - | 1.93 | 50.5 | 57 | 1.07 | 1.96 | 48.5 | 56 | 1.04 | 1.95 | 49.5 | 56 |
| | Mean | 0.76 | 1.45 | 55.9 | 105 | 0.78 | 1.48 | 53.3 | 202 | 0.77 | 1.47 | 54.5 | 194 |
| $M_2$ | $T_1$ | 1.30 | 2.20 | 45.8 | 49 | 1.32 | 2.17 | 44.0 | 49 | 1.31 | 2.19 | 44.9 | 49 |
| | $T_2$ | 0.11 | 0.37 | 74.6 | 649 | 0.11 | 0.42 | 70.7 | 715 | 0.11 | 0.40 | 72.7 | 682 |
| | $T_3$ | 0.57 | 1.23 | 55.2 | 105 | 0.50 | 1.33 | 52.5 | 113 | 0.59 | 1.28 | 53.9 | 109 |
| | $T_4$ | 0.77 | 1.55 | 53.3 | 78 | 0.76 | 1.61 | 50.5 | 77 | 0.77 | 1.58 | 51.9 | 78 |
| | $T_5$ | 1.05 | 1.96 | 50.5 | 59 | 1.09 | 1.95 | 48.4 | 57 | 1.07 | 1.96 | 49.5 | 58 |
| | Mean | 0.76 | 1.46 | 55.9 | 188 | 0.78 | 1.50 | 53.2 | 202 | 0.77 | 1.48 | 54.5 | 195 |
| Mean | $T_1$ | 1.31 | 2.20 | 45.1 | 48 | 1.31 | 2.15 | 44.1 | 49 | 1.31 | 2.17 | 44.6 | 49 |
| | $T_2$ | 0.11 | 0.37 | 75.5 | 645 | 0.11 | 0.43 | 70.9 | 718 | 0.11 | 0.40 | 73.2 | 682 |
| | $T_3$ | 0.58 | 1.24 | 55.2 | 103 | 0.60 | 1.36 | 52.4 | 112 | 0.59 | 1.30 | 53.8 | 107 |
| | $T_4$ | 0.77 | 1.54 | 53.0 | 78 | 0.79 | 1.56 | 50.0 | 76 | 0.77 | 1.55 | 51.7 | 77 |
| | $T_5$ | 1.03 | 1.59 | 50.5 | 58 | 1.08 | 1.96 | 48.5 | 57 | 1.06 | 1.95 | 49.5 | 57 |
| | Mean | 0.76 | 1.46 | 55.9 | 186 | 0.78 | 1.49 | 53.3 | 202 | 0.77 | 1.47 | 54.6 | 10 |
| CD : S | | | | | | | | | | NS | NS | 0.5 | 1 |
| | M | | | | | | | | | NS | NS | NS | NS |
| | T | | | | | | | | | 0.06 | 0.06 | 0.8 | 6 |
| | SxT | | | | | | | | | NS | NS | NS | NS |
| | MxT | | | | | | | | | NS | NS | NS | NS |
| | SxMxT | | | | | | | | | NS | NS | 1.5 | NS |

Treatment details as in the text

be attributed to the direct and indirect effect of coirpith. The direct effect attributed to the supplementation of N through decomposition product and indirect effect might be due to improvement in pore space and maximum water holding capacity which favoured the root nodules formation leading to more biological N fixation by cowpea. It is worth to mention that the number of nodules in 100% (225 per pot) and 75% coirpith (204 per pot) media were approximately 20 times more than that of the medium containing 100% soil (12 per pot). Fertigation and spraying method recorded high total N which might be due to increased activity of N fixing micro organism by fertigation.

The available N was improved by the incorporation of coirpith in the potting medium which might be due to high biological N fixation by improved aeration and decomposed products of coirpith. Similarly available P and K status were also improved by the addition of coirpith which may be ascribed to high nutreient status and decomposed product of coirpith. Fertigation method registered low available nutrients which might be due to high nutrient uptake by cowpea plant under fertigation treatments. The available nutrient status was decreased from flowering to harvest stage due to crop removal.

## Yield, crude protein and nutrient uptake

The coirpith containing media proved their superiority over 100% soil medium (Table 4). The beneficial effect of incorporation of coirpith may be attributed to the improvement in soil physical conditions besides supplementing the plant nutrients. The high availability of nutrients released by the decomposition of coirpith themselves and a favourable warm microclimatic condition prevailed during crop growth could have resulted in efficient utilisation of nutrients leading to increased yield of cowpea.

Table 3. Effect of treatments on chemical properties of the potting medium

| Treatments | | Flowering stage | | | | | | Harvest stage | | | | | | | Mean (stages) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC ($dSm^{-1}$) | Available N (ppm) | Available P (ppm) | Available K (ppm) | Total N (%) | pH | EC ($dSm^{-1}$) | Available N (ppm) | Available P (ppm) | Available K (ppm) | Organic carbon (%) | Total N (%) | pH | EC ($dSm^{-1}$) | Available N (ppm) | Available P (ppm) | Available K (ppm) | Total N (%) |
| $M_1$ | $T_1$ | 8.73 | 0.225 | 75.9 | 9.1 | 440 | 0.126 | 8.53 | 0.263 | 64.1 | 6.2 | 405 | 0.47 | 0.111 | 8.63 | 0.244 | 70.0 | 7.6 | 423 | 0.119 |
| | $T_2$ | 6.40 | 0.327 | 57.0 | 13.2 | 660 | 0.196 | 6.57 | 0.331 | 61.7 | 11.4 | 562 | 24.60 | 0.803 | 6.48 | 0.329 | 59.3 | 12.3 | 611 | 0.499 |
| | $T_3$ | 7.73 | 0.535 | 78.1 | 12.7 | 590 | 0.185 | 7.67 | 0.753 | 69.4 | 3.2 | 538 | 4.25 | 0.192 | 7.70 | 0.644 | 73.8 | 8.0 | 564 | 0.118 |
| | $T_4$ | 8.03 | 0.228 | 79.3 | 11.5 | 560 | 0.168 | 8.03 | 0.609 | 61.0 | 4.2 | 533 | 1.59 | 0.177 | 8.03 | 0.419 | 70.2 | 7.8 | 546 | 0.173 |
| | $T_5$ | 8.37 | 0.256 | 81.1 | 11.8 | 535 | 0.138 | 8.23 | 0.419 | 59.3 | 4.4 | 505 | 0.90 | 0.161 | 8.30 | 0.338 | 70.2 | 8.1 | 520 | 0.150 |
| | Mean | 7.85 | 0.314 | 74.3 | 11.6 | 557 | 0.163 | 7.81 | 0.475 | 63.1 | 5.9 | 509 | 6.37 | 0.289 | 7.76 | 0.395 | 68.7 | 8.8 | 533 | 0.226 |
| $M_2$ | $T_1$ | 8.67 | 0.239 | 75.1 | 8.9 | 431 | 0.131 | 8.77 | 0.277 | 60.0 | 5.8 | 390 | 0.44 | 0.115 | 8.72 | 0.258 | 67.5 | 7.4 | 410 | 0.123 |
| | $T_2$ | 6.67 | 0.289 | 51.8 | 13.2 | 527 | 0.186 | 6.90 | 0.328 | 55.2 | 11.8 | 566 | 23.80 | 0.917 | 6.78 | 0.309 | 53.5 | 12.5 | 546 | 0.552 |
| | $T_3$ | 7.70 | 0.669 | 77.6 | 11.7 | 564 | 0.138 | 6.10 | 1.060 | 64.4 | 1.7 | 530 | 4.21 | 0.119 | 6.90 | 0.864 | 71.0 | 6.7 | 547 | 0.194 |
| | $T_4$ | 7.96 | 0.210 | 75.3 | 10.8 | 548 | 0.166 | 8.10 | 0.587 | 59.7 | 3.8 | 530 | 1.46 | 0.185 | 8.03 | 0.398 | 67.5 | 7.3 | 539 | 0.176 |
| | $T_5$ | 8.37 | 0.239 | 71.8 | 10.1 | 519 | 0.141 | 8.37 | 0.362 | 58.8 | 4.1 | 489 | 0.86 | 0.157 | 8.37 | 0.301 | 65.3 | 7.1 | 504 | 0.148 |
| | Mean | 7.87 | 0.329 | 70.3 | 11.0 | 518 | 0.162 | 7.67 | 0.523 | 59.6 | 5.4 | 501 | 6.15 | 0.315 | 7.80 | 0.426 | 65.0 | 8.2 | 509 | 0.239 |
| Mean | $T_1$ | 8.70 | 0.232 | 75.5 | 9.0 | 435 | 0.129 | 8.65 | 0.270 | 62.0 | 6.0 | 398 | 0.46 | 0.113 | 8.68 | 0.251 | 68.7 | 7.5 | 416 | 0.191 |
| | $T_2$ | 6.53 | 0.308 | 54.4 | 13.2 | 593 | 0.191 | 6.73 | 0.330 | 58.4 | 11.6 | 564 | 24.20 | 0.860 | 6.63 | 0.319 | 56.4 | 18.4 | 579 | 0.525 |
| | $T_3$ | 7.72 | 0.602 | 77.9 | 12.2 | 577 | 0.187 | 6.88 | 0.907 | 66.9 | 2.5 | 534 | 4.23 | 0.196 | 7.30 | 0.754 | 72.4 | 7.3 | 556 | 0.191 |
| | $T_4$ | 8.00 | 0.219 | 77.3 | 11.5 | 554 | 0.167 | 8.07 | 0.598 | 60.3 | 4.0 | 531 | 1.53 | 0.181 | 8.03 | 0.408 | 68.8 | 7.6 | 543 | 0.174 |
| | $T_5$ | 8.37 | 0.247 | 76.5 | 11.0 | 527 | 0.139 | 8.30 | 0.391 | 59.1 | 4.2 | 497 | 0.88 | 0.159 | 8.33 | 0.319 | 67.8 | 7.6 | 512 | 0.147 |
| | Mean | 7.86 | 0.322 | 72.3 | 11.3 | 537 | 0.163 | 7.73 | 0.499 | 61.3 | 5.7 | 506 | 6.26 | 0.302 | 7.83 | 0.410 | 66.8 | 8.5 | 521 | 0.232 |
| CD | S | | | | | | | | | | | | | | NS | 0.023 | 0.8 | 13 | 0.006 | |
| (p=0.05) | | | | | | | | | | | | | | | | | 0.3 | 13 | 0.006 | |
| | M | | | | | | | | | | | | 0.15 | NS | 0.023 | 0.8 | 0.5 | 20 | 0.009 | |
| | T | | | | | | | | | | | | 0.24 | 0.53 | 0.036 | 1.3 | 18 | 0.008 | | |
| | SxM | | | | | | | | | | | | NS | NS | NS | NS | 1.8 | 0.6 | NS | 0.013 |
| | SxT | | | | | | | | | | | | | | NS | 0.050 | 0.6 | 29 | 0.013 | |
| | MxT | | | | | | | | | | | | 0.33 | NS | 0.050 | 1.8 | 2.6 | NS | 11 | NS |
| | SxMxT | | | | | | | | | | | | | | NS | 0.071 | | | | |

Treatment details as in the text.

Table 4. Effect of treatments on growth parameters and nutrient uptake of Cowpea

| Treatments | | Root volume (ml pot$^{-1}$) | Root nodules pe=pot | G-reen pod yield (g pot$^{-1}$) | Dry matter production (g pot$^{-1}$) | N-uptake (mg pot$^{-1}$) | P-uptake (mg pot$^{-1}$) | K-uptake (mg pot$^{-1}$) | Crude protein content (%) |
|---|---|---|---|---|---|---|---|---|---|
| $M_1$ | $T_1$ | 10.0 | 120 | 55.6 | 36.8 | 1030 | 62.2 | 801 | 25.5 |
| | $T_2$ | 70.1 | 223 | 68.8 | 49.6 | 1375 | 77.3 | 1172 | 26.3 |
| | $T_3$ | 40.7 | 204 | 108.0 | 62-6 | 1899 | 126.0 | 1312 | 26.4 |
| | $T_4$ | 10.9 | 191 | 87.8 | 55-5 | 1545 | 107.0 | 1217 | 25.4 |
| | $P_5$ | 17.8 | 167 | 74.3 | 51-0 | 1368 | 93.3 | 1132 | 25-7 |
| | Mean | 31.9 | 159 | 78.8 | 51-1 | 1443 | 93.2 | 1132 | 25-7 |
| $M_2$ | $T_1$ | 10.8 | 120 | 64.7 | 41.7 | 1164 | 73.6 | 715 | 25.6 |
| | $T_2$ | 71.1 | 227 | 74.6 | 54.3 | 1479 | 92.5 | 1257 | 26.5 |
| | $T_3$ | 40.6 | 203 | 112.0 | 68.9 | 2058 | 137.0 | 1488 | 26.8 |
| | $T_4$ | 21.0 | 192 | 92.7 | 59.4 | 1725 | 116.0 | 1296 | 26.4 |
| | $T_5$ | 18.1 | 163 | 81.9 | 56.9 | 1574 | 115.0 | 1241 | 26.2 |
| | Mean | 32.3 | 159 | 85.2 | 56.3 | 1600 | 107.0 | 1199 | 26.3 |
| Mean | $T_1$ | 10.4 | 12 | 60.1 | 39.2 | 1097 | 67.9 | 758 | 25.5 |
| | $T_2$ | 70.6 | 225 | 71.1 | 52.0 | 1427 | 84.9 | 1214 | 26.4 |
| | $T_3$ | 40.7 | 204 | 110.0 | 65.8 | 1979 | 132.0 | 1400 | 26.6 |
| | $T_4$ | 22.0 | 191 | 90.3 | 57.5 | 1635 | 112.0 | 1257 | 26.2 |
| | $T_5$ | 18.0 | 165 | 78.1 | 54.0 | 1471 | 104.0 | 1187 | 26.0 |
| | Mean | 32.1 | 159 | 82.0 | 53.7 | 1522 | 100.0 | 1163 | 26.1 |
| CD (P=0.05) | M | NS | NS | 2.1 | 0.9 | 28 | 2.2 | 35 | 0.1 |
| | T | 1.0 | 5 | 3.3 | 1.4 | 44 | 3.4 | 55 | 0.2 |
| | MxT | NS | NS | NS | NS | NS | 4.8 | 77 | NS |

Treatment details as in the text

Among the potting medium, 75% coirpith containing medium recorded highest yield (110 g pot$^{-1}$) followed by 50% coirpith medium (90.3 g pot$^{-1}$) which might be to favourable physico-chemical properties of the respective medium. Between the two methods of fertilizer application compared, application of 50% N and P as basal and 50% through fertigation at 15 days frequency and 2 rounds of 3% DAP spray gave higher green pod yield (85.2 g pot$^{-1}$) than basal application of full dose of N and P (78.8 g pot$^{-1}$). The yield increase due to fertigation + spraying treatment was 8.12% as compared to the basal application which might be due to better nutrient use efficiency by cowpea plant in the former method than latter. The influences by various methods on the pattern of crude protein content of pods and nutrient uptake by cowpea plants followed the similar trend as that of the yield.

## REFERENCES

GANAPATHI, T. (1991). **Effect of NPK, Gypsum and Coirpith on Nutrient Availability in Soil, Uptake and Yield of Rice.** M.Sc. (Ag.) Thesis. Tamil Nadu Agricultural University, Coimbatore.

PAPADOPOULOS, I. (1987). Nitrogen fertigation of green house grown tomato. **Commun. Soil Sci. Plant Anal., 18**: 897-907.

SARAVANAN, A. and NAMBISAN, K.M.P. (1995). Utilisation of coirpith as potculture medium for *Begonia semiperfloreus* **Madras Agric. J., 82**: 587-589.

VERDONCK, O. (1991). Horticultural Substrates. In: **21st Int. Course on Vegetable Production.** IAC. Wageningen. The Nether lands. 95 pp.

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